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Marks POLARIZING PLATES

Technical Data

Polarization of light is a phenomenon utilized today in many scientific and technical fields. Formerly, plane polarized light has been produced and analyzed almost universally by means of the Nicols Prism which however is so costly as to prohibit wider use. The development of a relatively inexpensive medium is therefore truly an achievement. Marks Polarizing Plates are the result of just such an accomplishment—a discovery whereby is produced almost completely polarized light. A glance at the actual photographs below indicate the efficiency of these plates.

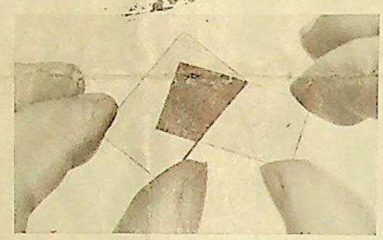

Photo Courtesy Scientific American

Two plates with their planes of Polarization at approximately 90° relative to each other.

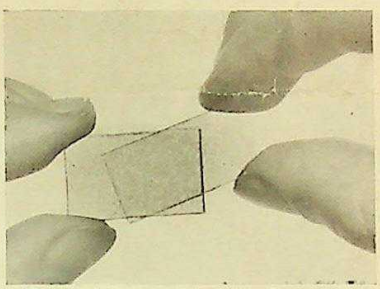

Photo Courtesy Scientific American

Same plates, with their planes of polarization approximately aligned relative to each other.

The SINGLE *MARKS* Polarizing Plate

ITS NATURE AND PROPERTIES

The single Marks Polarizing Plate consists of a glass plate, on one surface of which is a polarizing film. The polarizing film is an extremely thin coating adhering firmly to the glass face. Ordinary light upon being transmited through the coating emerges plane polarized light. The direction along the plate parallel to the plane of polarization of the emergent light beam is called the Main Axis of the Marks Polarizing Plate.

The polarization of the light is accomplished through the interaction of the light with the special substances comprising the coating and occurs simultaneously in two ways. In the first way, at the surface of the coating, a part of the light is split into two oppositely polarized beams;—a transmitted beam and a regularly reflected beam. Both beams are strongly polarized for all angles of incidence of the beam of ordinary light, from zero to normal incidence inclusive. The transmitted beam's plane of polarization is parallel to the Main Axis, and the reflected beam's plane of polarization is at right angles to the Main Axis. This is quite different from the phenomenon occurring at the surface of an isotropic medium such as a glass surface, in which the light at zero and normal incidence shows no polarization in the reflected and transmitted beams, and a maximum polarization is reached at some particular angle of incidence in between, 57° usually for glass. The polarization of light rays transmitted through the Marks Polarizing Plate is equally effective at all angles of incidence.

PHYSICAL DATA:

Let I_0 be the intensity of the light falling on a polarizing plate, and let I be the intensity of light after it issues from the second polarizing plate. Then experimentally and theoretically the following relation is found:

$$\frac{I}{I_0} = c + (b - c)\cos^2\theta$$

where θ = angle thru which the two plates have been turned from the position of maximum light transmission thru two plates; c = fraction of the light passing thru the plates when $\theta = 90°$; b = fraction of the light that passes thru two plates when $\theta = 0°$. The ratio of maximum intensity to minimum intensity of light passing thru two plates as the angle is changed from 0 to 90° is b/c. Exper-

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imental values of these constants for a typical specimen set of Polarizing Plates are given herewith:

$$b = 0.36 \qquad \frac{b}{c} = 18$$

$$c = 0.02$$

In some cases b/c is greater than 18, up to 30, or even greater.

Experiments show that Marks Polarizing Plates are approximately 45% transparent to ordinary light. When looking thru two plates when the angle θ is 0° they appear transparent (36%) and colorless, but when they are turned thru 90° from this position they appear black, and in this position transmit about 2% of the light impinging on the first plate. If carefully observed in this position of maximum extinction it will be noticed that the color is more nearly blue-black.

The following table, taken from experimental data, shows the percentage transmission of a polarized beam of monochromatic light thru a single Marks Polarizing Plate, the plane of polarization being respectively parallel and perpendicular to the Main Axis:

Wavelength Millimicrons	Transmission Parallel	Transmission Perpendicular
	%	%
400	70	3.5
450	76	3.5
500	82	3.0
550	84	2.5
600	85	2.0
650	86	2.0
700	86	2.0

There are no absorption bands anywhere in the visible spectrum.

Marks Polarizing Plates have proved to last indefinitely provided they are not heated above 75° C. (167° F.) and when unmounted are not exposed to excessively moist conditions and are not scratched by polishing the polarizing surface with a coarse material.

MOUNTING:—Usually a coverglass is placed over the polarizing coating with or without a transparent medium between the coverglass and the coating. Methods of mounting will be furnished on request.

The single Marks Polarizing Plate may be obtained laminated with a coverglass permanently cemented in place over the polarizing coating. The laminated single Marks Polarizing Plates are obtainable in circles which are extremely convenient units for mounting in optical instruments.

USES IN THE INSTRUMENT FIELD

The single Marks Polarizing Plate is especially suitable where high transmission of light together with a strong polarization is required as for instance in nonglare work in sextants, binoculars, photographic filters, the opthalmometer, the retinoscope and opthalmoscope: in Kerr electro-optic shutters, etc.

POLARIZED PRODUCTS CO.

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